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CLAIMS

1. A method of planarizing a microelectronic-device substrate assembly, comprising:

removing material from a substrate assembly by pressing the substrate assembly against a planarizing surface of a planarizing pad and moving the substrate assembly across the planarizing surface; and

replacing at least a portion of a used volume of planarizing solution on the planarizing surface with fresh planarizing solution by actively removing used planarizing solution from an accumulation zone on the planarizing surface adjacent to a planarizing zone on the planarizing surface with a removing unit other than solely the movement of the pad and depositing fresh planarizing solution onto the planarizing pad.

2. The method of claim 1 wherein removing material from the substrate assembly comprises:

performing a first planarizing stage of the substrate assembly by depositing an initial volume of planarizing solution onto the planarizing surface and initially moving the substrate assembly across the planarizing surface, at least a portion of the initial volume of planarizing solution becoming the used volume planarizing solution on the planarizing pad;

stopping the first planarizing stage prior to replacing at least a portion of the used planarizing solution with the fresh planarizing solution; and

performing a second planarizing stage of the substrate assembly after replacing the used planarizing solution with the fresh planarizing solution.

3. The method of claim 2 wherein the substrate assembly has an aluminum cover layer and the planarizing solution has alumina abrasive particles, and wherein:

the first planarizing stage comprises planarizing the substrate assembly with the initial volume of planarizing solution for approximately 100 seconds; and

the second planarizing stage comprises planarizing the substrate assembly with the fresh planarizing solution for approximately 50 seconds.

4. The method of claim 2 wherein the substrate assembly has a metal cover layer and the planarizing solution has abrasive particles, and wherein:

the first planarizing stage comprises planarizing the substrate assembly with the initial volume of planarizing solution for a first period of time; and

the second planarizing stage comprises planarizing the substrate assembly with the fresh planarizing solution for a second period of time.

5. The method of claim 4 wherein the metal cover layer comprises aluminum.

6. The method of claim 4 wherein the metal cover layer comprises tungsten.

7. The method of claim 4 wherein the metal cover layer comprises copper.

8. The method of claim 2 wherein the substrate assembly has a dielectric cover layer and the planarizing solution has abrasive particles, and wherein:

the first planarizing stage comprises planarizing the substrate assembly with the initial volume of planarizing solution for a first period of time; and

the second planarizing stage comprises planarizing the substrate assembly with the fresh planarizing solution for a second period of time.

9. The method of claim 2 wherein the removing unit comprises a vacuum assembly attached to an actuator, the vacuum assembly including a nozzle and a vacuum source coupled to the nozzle, and wherein actively removing the used planarizing solution comprises sweeping the vacuum assembly across the pad to move the nozzle through a portion of an accumulation size and sucking the used planarizing solution through the nozzle between the first and second planarizing stages.

10. The method of claim 2 wherein the removing unit comprises a rotating brush coupled to an actuator, and wherein actively removing the used planarizing solution comprises sweeping the rotating brush across the planarizing surface in a direction counter to a rotational direction of the brush at the planarizing surface between the first and second planarizing stages.

11. The method of claim 2 wherein the removing unit comprises a brush coupled to an actuator, and wherein actively removing the used planarizing solution comprises rotating the brush across the planarizing surface in a direction that pushes the used planarizing solution away from the accumulation zone.

12. The method of claim 2 wherein the planarizing pad has a plurality of holes in an accumulation zone extending through the planarizing pad from the planarizing surface, and the removing unit comprises a vacuum chamber operatively coupled to the holes in the accumulation chamber, and wherein actively removing the used planarizing solution comprises sucking the used planarizing solution through the holes in the planarizing pad by drawing a vacuum in the vacuum chamber.

13. The method of claim 2 wherein actively removing the used planarizing solution comprises sweeping at least a portion of the used planarizing fluid from the planarizing pad between the first and second planarizing stages.

14. The method of claim 13 wherein a wiper blade is attached to an arm, and wherein sweeping at least a portion of the used planarizing solution from the accumulation zone comprises moving the arm to sweep the wiper blade across at least a portion of the planarizing pad between the first and second planarizing stages.

15. The method of claim 1 wherein removing material from the substrate assembly and replacing at least a portion of the used volume of planarizing solution occur contemporaneously to continuously planarize the substrate assembly.

16. The method of claim 15 wherein the planarizing pad has a plurality of holes in an accumulation zone, the holes extending through the planarizing pad from the planarizing surface, and the removing unit comprises a vacuum chamber operatively coupled to the holes, and wherein actively removing the used planarizing solution comprises sucking the used planarizing solution through the holes in the planarizing pad by drawing a vacuum in the vacuum chamber while the substrate is pressed against and moved across the planarizing surface.

17. The method of claim 15 wherein actively removing the used planarizing solution comprises wiping at least a portion of the used planarizing fluid from the planarizing pad while the substrate assembly is pressed against and moved across the planarizing surface.

18. The method of claim 17 wherein a wiper blade is attached to a substrate carrier assembly to extend across at least a portion of an accumulation zone in which the used planarizing solution accumulates, and wherein wiping at least a

portion of the used planarizing solution from the accumulation zone comprises rotating the carrier assembly to sweep the wiper blade through at least a portion of the accumulation zone in engagement with the planarizing surface.

19. The method of claim 11 wherein wiping used planarizing fluid from the pad comprises moving the used planarizing solution to a location on the pad where the used solution can be removed from the pad by one of a vacuum nozzle or a drain.

20. The method of claim 15 wherein a rotating brush is attached to a substrate carrier assembly to extend across at least a portion of an accumulation zone on the pad, and wherein actively removing used planarizing solution from the pad comprises translating the carrier assembly to move the rotating brush through at least a portion of the accumulation zone in a direction counter to a rotational direction of the brush at the planarizing surface.

21. The method of claim 15 wherein a vacuum assembly with an elongated nozzle is attached to a substrate carrier assembly having a substrate holder to hold the substrate assembly, the elongated nozzle extending across at least a portion of an accumulation zone, and wherein actively removing used planarizing solution from the pad comprises translating the carrier assembly to move the nozzle through at least a portion of the accumulation zone and sucking used planarizing solution into the nozzle.

22. The method of claim 1 wherein replacing at least a portion of a used volume of planarizing solution comprises performing the act of replacing after planarizing each substrate assembly.

23. The method of claim 1 wherein the act of replacing occurs without removing the polishing pad from a planarizing station under a substrate holder.

24. A method of planarizing microelectronic-device substrate assemblies, comprising:

depositing fresh planarizing solution onto a planarizing surface of a stationary planarizing pad;

removing material from a substrate assembly by pressing the substrate assembly against the planarizing surface, holding the planarizing pad stationary, and moving the substrate assembly across the planarizing surface; and

actively removing planarizing solution deposited on the planarizing surface from the planarizing pad with a removing unit.

25. The method of claim 24 wherein:

depositing fresh planarizing solution and removing material from the substrate comprises performing a first planarizing stage by dispensing an initial volume of fresh planarizing solution onto the pad and removing material from the substrate to an intermediate point, and performing a second planarizing stage by dispensing a subsequent volume of planarizing solution onto the pad and removing additional material from the substrate to a final endpoint; and

actively removing planarizing solution from the pad is performed between the first and second planarizing stages to remove the initial volume of planarizing solution used during the first planarizing stage.

26. The method of claim 24 wherein depositing fresh planarizing solution onto the pad, removing material from the substrate assembly, and actively removing used planarizing solution from the pad occur contemporaneously to continuously planarize the substrate assembly.

27. A method of planarizing a microelectronic-device substrate assembly, comprising:

removing material from a substrate assembly by pressing the substrate assembly against a planarizing surface of a planarizing pad and moving the substrate assembly across the planarizing surface; and

exchanging at least a portion of a used volume of planarizing solution on the planarizing pad with fresh planarizing solution by actively removing used planarizing solution from an accumulation zone on the planarizing pad adjacent to a planarizing zone with an active removing unit other than solely the movement of the pad and depositing fresh planarizing solution in the planarizing zone.

28. The method of claim 27 wherein removing material from the substrate assembly comprises:

performing a first planarizing stage of the substrate assembly by depositing an initial volume of planarizing solution onto the planarizing surface and initially moving the substrate assembly across the planarizing surface, at least a portion of the initial volume of planarizing solution becoming the used volume planarizing solution on the planarizing pad;

stopping the first planarizing stage prior to exchanging at least a portion of the used planarizing solution with the fresh planarizing solution; and

performing a second planarizing stage of the substrate assembly after exchanging the used planarizing solution with the fresh planarizing solution.

29. The method of claim 28 wherein the substrate assembly has an aluminum cover layer and the planarizing solution has alumina abrasive particles, and wherein:

the first planarizing stage comprises planarizing the substrate assembly with the initial volume of planarizing solution for approximately 100 seconds; and

the second planarizing stage comprises planarizing the substrate assembly with the fresh planarizing solution for approximately 50 seconds.

30. The method of claim 28 wherein the removing unit comprises a vacuum assembly attached to an actuator, the vacuum assembly including a nozzle and a vacuum source coupled to the nozzle, and wherein actively removing the used planarizing solution comprises sweeping the vacuum assembly across the pad to move the nozzle through at least a portion of the accumulation zone and sucking the used planarizing solution through the nozzle between the first and second planarizing stages.

31. The method of claim 28 wherein the removing unit comprises a rotating brush coupled to an actuator, and wherein actively removing the used planarizing solution comprises sweeping the rotating brush across the planarizing surface in a direction counter to a rotational direction of the brush at the planarizing surface between the first and second planarizing stages.

32. The method of claim 27 wherein removing material from the substrate assembly and exchanging at least a portion of the used volume of planarizing solution occur contemporaneously to continuously planarize the substrate assembly.

33. The method of claim 32 wherein the planarizing pad has a plurality of holes in the accumulation zone, the holes extending through the planarizing pad from the planarizing surface, and the removing unit comprises a

vacuum chamber operatively coupled to the holes, and wherein actively removing the used planarizing solution comprises sucking the used planarizing solution through the holes in the planarizing pad by drawing a vacuum in the vacuum chamber while the substrate is pressed against and moved across the planarizing surface.

34. The method of claim 32 wherein a rotating brush is attached to a substrate carrier assembly to extend across at least a portion of the accumulation zone on the pad, and wherein actively removing used planarizing solution from the pad comprises rotating the carrier assembly to move the rotating brush through at least a portion of the accumulation zone in a direction counter to a rotational direction of the brush at the planarizing surface.

35. The method of claim 32 wherein a vacuum assembly with an elongated nozzle is attached to a substrate carrier assembly having a substrate holder to hold the substrate assembly, the elongated nozzle extending across at least a portion of the accumulation zone, and wherein actively removing used planarizing solution from the pad comprises rotating the carrier assembly to move the nozzle through at least a portion of the accumulation zone and sucking used planarizing solution into the nozzle.

36. A method of planarizing a microelectronic-device substrate assembly, comprising:

removing material from a substrate assembly by pressing the substrate assembly against a planarizing surface of a planarizing pad and moving the substrate assembly across the planarizing surface; and

maintaining an ionic charge level of the planarizing solution below a threshold level by exchanging used planarizing solution deposited onto the planarizing pad with fresh planarizing solution using means other than solely the movement of the pad, the threshold level being one of charge level at which ionic material removed

from the substrate assembly substantially reattaches to the substrate assembly, or a charge level at which abrasive particles in the slurry substantially agglomerate in the slurry or substantially accumulate on the planarizing surface.

37. The method of claim 36 wherein removing material from the substrate assembly comprises:

performing a first planarizing stage of the substrate assembly by depositing an initial volume of planarizing solution onto the planarizing surface and initially moving the substrate assembly across the planarizing surface, at least a portion of the initial volume of planarizing solution becoming the used volume planarizing solution on the planarizing pad;

stopping the first planarizing stage prior to exchanging at least a portion of the used planarizing solution with the fresh planarizing solution; and

performing a second planarizing stage of the substrate assembly after exchanging the used planarizing solution with the fresh planarizing solution.

38. The method of claim 37 wherein the substrate assembly has an aluminum cover layer and the planarizing solution has alumina abrasive particles, and wherein:

the first planarizing stage comprises planarizing the substrate assembly with the initial volume of planarizing solution for approximately 100 seconds; and

the second planarizing stage comprises planarizing the substrate assembly with the fresh planarizing solution for approximately 50 seconds.

39. The method of claim 37 wherein the removing unit comprises a vacuum assembly attached to an actuator, the vacuum assembly including a nozzle and a vacuum source coupled to the nozzle, and wherein actively removing the used planarizing solution comprises sweeping the vacuum assembly across the pad to move the nozzle through at least a portion of the accumulation zone and sucking the used

planarizing solution through the nozzle between the first and second planarizing stages.

40. The method of claim 37 wherein the removing unit comprises a rotating brush coupled to an actuator, and wherein actively removing the used planarizing solution comprises sweeping the rotating brush across the planarizing surface in a direction counter to a rotational direction of the brush at the planarizing surface between the first and second planarizing stages.

41. The method of claim 36 wherein removing material from the substrate assembly and exchanging at least a portion of the used volume of planarizing solution occur contemporaneously to continuously planarize the substrate assembly.

42. The method of claim 41 wherein the planarizing pad has a plurality of holes in an accumulation zone, the holes extending through the planarizing pad from the planarizing surface, and the removing unit comprises a vacuum chamber operatively coupled to the holes, and wherein actively removing the used planarizing solution comprises sucking the used planarizing solution through the holes in the planarizing pad by drawing a vacuum in the vacuum chamber while the substrate is pressed against and moved across the planarizing surface.

43. The method of claim 41 wherein a rotating brush is attached to a substrate carrier assembly to extend across at least a portion of an accumulation zone on the pad, and wherein actively removing used planarizing solution from the pad comprises rotating the carrier assembly to move the rotating brush through at least a portion of the accumulation zone in a direction counter to a rotational direction of the brush at the planarizing surface.

44. The method of claim 41 wherein a vacuum assembly with an elongated nozzle is attached to a substrate carrier assembly having a substrate holder to hold the substrate assembly, the elongated nozzle extending across at least a portion of an accumulation zone, and wherein actively removing used planarizing solution from the pad comprises rotating the carrier assembly to move the nozzle through at least a portion of the accumulation zone and sucking used planarizing solution into the nozzle.

45. A method of planarizing a microelectronic-device substrate assembly, comprising:

removing material from a substrate assembly by pressing the substrate assembly against a planarizing surface of a planarizing pad and moving the substrate assembly across the planarizing surface; and

maintaining an a pH level of the planarizing solution below a threshold level by exchanging used planarizing solution deposited onto the planarizing pad with fresh planarizing solution using means other than solely the movement of the pad, the threshold level being a pH level that adversely affects the substrate assembly.

46. A method of planarizing a microelectronic-device substrate assembly, comprising:

removing material from a substrate assembly by pressing the substrate assembly against a planarizing surface of a planarizing pad and moving the substrate assembly across the planarizing surface; and

maintaining a percent solids level of the planarizing solution below a threshold level by exchanging used planarizing solution deposited onto the planarizing pad with fresh planarizing solution using means other than solely the movement of the pad, the threshold level being one of a solids level at which material removed from the substrate assembly substantially reattaches to the substrate assembly, or a solids level

at which abrasive particles in the slurry substantially agglomerate in the slurry or substantially accumulate on the planarizing surface.

47. The method of claim 46 wherein maintaining a percent solids comprises keeping not more than 1% solids in the planarizing solution on the pad.

48. The method of claim 46 wherein maintaining a percent solids comprises keeping not more than 0.1% solids in the planarization solution on the pad.

49. A planarizing machine for planarizing microelectronic-device substrate assemblies, comprising:

a table with a support panel;

a planarizing pad including a planarizing surface facing away from the support panel, the planarizing pad being removably attached to the support panel;

a carrier assembly having a substrate holder positionable over the planarizing pad and a planarizing solution dispenser to dispense a fresh planarizing solution onto the planarizing surface, the substrate holder translating a substrate assembly over a planarizing zone of the planarizing surface during a planarizing cycle, and the substrate assembly pushing used planarizing solution deposited onto the planarizing pad into an accumulation zone on the planarizing surface adjacent to the planarizing zone; and

a planarizing solution removing unit at the accumulation zone, the removing unit actively removing used planarizing solution from at least a portion of the accumulation zone on the stationary planarizing pad.

50. The planarizing machine of claim 49 wherein the removing unit comprises a vacuum assembly having a nozzle positionable in the accumulation zone to be exposed to at least a portion of the used planarizing solution and a vacuum source coupled to the nozzle to suck the used planarizing solution through the nozzle.

51. The planarizing machine of claim 49 wherein:

the planarizing pad has a plurality of holes in the accumulation zone extending through the planarizing pad from the planarizing surface; and

the removing unit comprises a vacuum chamber operatively coupled to the holes in the planarizing pad and a vacuum source coupled to the vacuum chamber, the vacuum source sucking the used planarizing solution through the holes in the planarizing pad and the vacuum chamber.

52. The planarizing machine of claim 49 wherein the removing unit comprises a pipette having a pipe, a cylinder attached to the pipe and plunger coupled to the cylinder to draw a volume of fluid through the pipe and into the cylinder.

53. The planarizing machine of claim 49, further comprising a wiper blade attached to the carrier assembly to extend across at least a portion of the accumulation zone, the wiper blade being spaced apart from the substrate holder.

54. The planarizing machine of claim 49, further comprising a wiper blade attached to an arm separate from the carrier assembly, the arm being movable over the accumulation zone to sweep the wiper blade across at least a portion of the accumulation zone.

55. The planarizing machine of claim 49, further comprising a rotating brush attached to the carrier assembly, the rotating brush being spaced apart from the substrate holder and the rotating brush extending across at least a portion of the accumulation zone, the carrier assembly moving the rotating brush through at least a portion of the accumulation zone apart from the substrate assembly.

56. The planarizing machine of claim 49, further comprising a rotating brush attached to an actuator separate from the carrier assembly, the actuator sweeping the brush over at least a portion of the accumulation zone.

57. The planarizing machine of claim 49, further comprising a vacuum assembly attached to the carrier assembly, the vacuum assembly having a nozzle spaced apart from the substrate holder and the nozzle extending across at least a portion of the accumulation zone, the carrier assembly moving the nozzle through at least a portion of the accumulation zone apart from the substrate assembly.

58. The planarizing machine of claim 49, further comprising a vacuum assembly attached to an actuator separate from the carrier assembly, the vacuum assembly having a nozzle adapted to engage the planarizing surface of the pad, and the actuator sweeping the nozzle over at least a portion of the accumulation zone.

59. A planarizing machine for planarizing microelectronic-device substrate assemblies, comprising:

a table with a support panel;

a supply roller proximate to the support panel;

a take-up roller proximate to the support panel;

a web-format planarizing pad including a pre-operative portion wrapped around the supply roller, an operative portion removably attached to the support panel to remain stationary during a planarizing cycle, and a post-operative portion wrapped around the take-up roller, the planarizing pad having a planarizing surface exposed in the operative portion facing away from the support panel;

a carrier assembly having a substrate holder positionable over the planarizing pad and a planarizing solution dispenser to dispense a fresh planarizing solution onto the planarizing surface, the substrate holder translating a substrate

assembly over a planarizing zone of the planarizing surface during the planarizing cycle, and the substrate assembly pushing used planarizing solution deposited onto the planarizing pad into an accumulation zone on the planarizing surface adjacent to the planarizing zone; and

a planarizing solution removing unit other than the substrate assembly positioned proximate to the accumulation zone on the planarizing surface.

60. The planarizing machine of claim 59 wherein the removing unit comprises a vacuum assembly having a nozzle positionable in the accumulation zone to be exposed to at least a portion of the used planarizing solution and a vacuum source coupled to the nozzle to suck the used planarizing solution through the nozzle.

61. The planarizing machine of claim 59 wherein:

the planarizing pad has a plurality of holes in the accumulation zone extending through the planarizing pad from the planarizing surface; and

the removing unit comprises a vacuum chamber operatively coupled to the holes in the planarizing pad and a vacuum source coupled to the vacuum chamber, the vacuum source sucking the used planarizing solution through the holes in the planarizing pad and the vacuum chamber.

62. The planarizing machine of claim 59, further comprising a rotating brush attached to the carrier assembly, the rotating brush being spaced apart from the substrate holder and the rotating brush extending across at least a portion of the accumulation zone, the carrier assembly moving the rotating brush through at least a portion of the accumulation zone apart from the substrate assembly.

63. The planarizing machine of claim 59, further comprising a rotating brush attached to an actuator separate from the carrier assembly, the actuator

sweeping the brush over at least a portion of the accumulation zone between planarizing stages of a multi-stage planarizing cycle.

64. The planarizing machine of claim 59, further comprising a vacuum assembly attached to the carrier assembly, the vacuum assembly having a nozzle spaced apart from the substrate holder and the nozzle extending across at least a portion of the accumulation zone, the carrier assembly moving the nozzle through at least a portion of the accumulation zone apart from the substrate assembly.

65. The planarizing machine of claim 59, further comprising a vacuum assembly attached to an actuator separate from the carrier assembly, the vacuum assembly having a nozzle adapted to engage the planarizing surface of the pad, and the actuator sweeping the nozzle over at least a portion of the accumulation zone between planarizing stages of a multi-stage planarizing cycle.

66. A planarizing machine for planarizing microelectronic-device substrate assemblies, comprising:

a table with a stationary support panel;

a supply roller proximate to the support panel;

a take-up roller proximate to the support panel;

a web-format planarizing pad including a pre-operative portion wrapped around the supply roller, an operative portion removably attached to the support panel to remain stationary during a planarizing cycle, and a post-operative portion wrapped around the take-up roller, the planarizing pad having a planarizing surface exposed in the operative portion facing away from the support panel;

a carrier assembly having a substrate holder positionable over the planarizing pad and a planarizing solution dispenser to dispense a fresh planarizing solution onto the planarizing surface, the substrate holder translating a substrate assembly over a planarizing zone of the planarizing surface during the planarizing

cycle, and the substrate assembly pushing used planarizing solution deposited onto the planarizing pad into an accumulation zone on the planarizing surface adjacent to the planarizing zone; and

a planarizing solution removing unit at the accumulation zone to remove at least a portion of the planarizing solution deposited onto the planarizing surface while the planarizing pad remains stationary.

67. The planarizing machine of claim 66 wherein the removing unit comprises a vacuum assembly having a nozzle positionable in the accumulation zone to be exposed to at least a portion of the used planarizing solution and a vacuum source coupled to the nozzle to suck the used planarizing solution through the nozzle.

68. The planarizing machine of claim 66 wherein:

the planarizing pad has a plurality of holes in the accumulation zone extending through the planarizing pad from the planarizing surface; and

the removing unit comprises a vacuum chamber operatively coupled to the holes in the planarizing pad and a vacuum source coupled to the vacuum chamber, the vacuum source sucking the used planarizing solution through the holes in the planarizing pad and the vacuum chamber.

69. The planarizing machine of claim 66, further comprising a rotating brush attached to the carrier assembly, the rotating brush being spaced apart from the substrate holder and the rotating brush extending across at least a portion of the accumulation zone, the carrier assembly moving the rotating brush through at least a portion of the accumulation zone apart from the substrate assembly.

70. The planarizing machine of claim 66, further comprising a rotating brush attached to an actuator separate from the carrier assembly, the actuator

sweeping the brush over at least a portion of the accumulation zone between planarizing stages of a multi-stage planarizing cycle.

71. The planarizing machine of claim 66, further comprising a vacuum assembly attached to the carrier assembly, the vacuum assembly having a nozzle spaced apart from the substrate holder and the nozzle extending across at least a portion of the accumulation zone, the carrier assembly moving the nozzle through at least a portion of the accumulation zone apart from the substrate assembly.

72. The planarizing machine of claim 66, further comprising a vacuum assembly attached to an actuator separate from the carrier assembly, the vacuum assembly having a nozzle adapted to engage the planarizing surface of the pad, and the actuator sweeping the nozzle over at least a portion of the accumulation zone between planarizing stages of a multi-stage planarizing cycle.